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THE PRAGUE MEETINGS OF THE INTERNATIONAL GEODETIC AND GEOPHYSICAL UNION AND ITS METEOROLOGICAL SECTION

By HERBERT H. KIMBALL

Delegate from the American Geophysical Union

The Third General Assembly of the International Geodetic and Geophysical Union was held at Prague, Czechoslovakia, September 3 to 10, 1927. The first general assembly was held in Rome in May, 1922; the second in Madrid in October, 1924. Brief accounts of these two earlier meetings will be found in the MONTHLY WEATHER REVIEW for September, 1922, 50: 488, and November, 1924, 52: 533-536, respectively.

These general assemblies are made up of delegates from national unions of the countries affiliated with the International Research Council. In the case of the United States the delegates are, in general, named from the membership of the American Geophysical Union by the National Academy of Sciences and the National Research Council. The following were the delegates named for the third general assembly:

Dr. Louis A. Bauer, director, department of terrestrial magnetism of the Carnegie Institution of Washington;

Dr. William Bowie, chief, division of geodesy, United States Coast and Geodetic Survey;

Commander A. B. Cook, United States Navy;

Dr. J. H. Dellinger, senior physicist, radio section, United States Bureau of Standards;

Commander N. H. Heck, chief, division of terrestrial magnetism and seismology, United States Coast and Geodetic Survey;

Dr. Herbert H. Kimball, meteorologist, in charge solar radiation section, United States Weather Bureau;

Mr. W. D. Lambert, mathematician, division of geodesy, United States Coast and Geodetic Survey;

Dr. R. A. Millikan, director, California Institute of Technology, Pasadena, Calif.;

Dr. Harry Fielding Reid, professor of dynamic geology, Johns Hopkins University;

Guest of the union:

Prof. L. C. Graton, department of geology, Harvard University.

The wives and other members of families of delegates increased the number in the official party from the United States to 20 persons. It was a source of regret that Doctor Millikan was not able to reach Prague.

In the absence of Doctor Washington, chairman of the American Geophysical Union, Doctor Reid was selected by the delegates to act as their chairman.

The official opening of the general conference occurred on the morning of September 3 in the chamber of the House of Parliament. In the regretted absence of President Masaryk, of the Czechoslovakian Republic, on

account of illness, President Lallemand, of the union, presided, and also responded to speeches of welcome by national and city officials and the president of the Geodetic and Geophysical Committee of Czechoslovakia.

Following these ceremonies there was a short plenary session of the union at which the general secretary presented his report. It covered the period from April 1, 1924, to March 31, 1927. On the latter date 30 countries were affiliated in the union.

During this period there had been received from all sources, including the balance brought forward, 901,948.20 francs.¹ There had been disbursed 618,021 francs, leaving a balance of 283,927 francs.

The principal disbursements were through the sections of the union, as follows:

	Francs
Section of geodesy.....	205,010.00
Section of seismology.....	81,120.00
Section of meteorology.....	88,071.00
Section of terrestrial magnetism.....	81,699.40
Section of oceanography.....	70,205.00
Section of volcanology.....	59,591.00
Section of hydrology.....	6,000.00

The section of scientific hydrology received funds amounting to 30,000 francs from sources outside of the general funds of the union. These latter are received from the Governments of the 30 affiliated countries, the annual subscriptions varying from 20,800 francs for eight of the larger countries, including the United States, to 2,600 francs for small countries. The number of votes to which a country is entitled in either the plenary meetings or the meetings of a section depends upon the amount of its contribution, the maximum for any country being six votes.

The election of a president of the union, which was scheduled for this meeting, was postponed until the closing plenary meeting.

Delegates from the American Geophysical Union are accredited to the international union as a whole, and are free to participate in any of the section meetings. As a matter of fact, since meetings of all the sections are held at the same hours, delegates confine themselves almost exclusively to the meetings of the section dealing with their special branch of science. The writer was therefore in attendance upon the meetings of the meteorological section only.

Beginning with the session on the afternoon of September 3 and ending with that on the morning of September 10, the section held eight sessions. The first, presided over by the vice president, General Delcambre, received certain reports. At the second session, on Monday morning, September 5, the president, Sir Napier Shaw, reported on the work done by the bureau of the section during the three years that had elapsed since

¹ The approximate value of a franc is 3.94 cents

the last (Madrid) meeting. This embraced the publication of the *procès-verbaux* of the Madrid meeting in 1924, including an annexe on radiation in relation to meteorology, which contained data that was worthy of a wider distribution than the *procès-verbaux* has received. The delegates were therefore asked to designate libraries in their countries that should receive the publications of the section.

With reference to the appropriation of £400 for the purchase of pyrheliometers, three had been purchased at a total cost of £130.579. One was sent to the Apia Observatory, Samoa, a second to Spitzbergen, and a third was placed in the hands of M. Jaumotte, of Brussels, where it is now held for test before installing it in the Belgian Congo.

Four photometers, constructed after designs by Doctor Richardson, for measuring the albedo of different surfaces, have been obtained at a total cost of £40.2. One of these was on exhibition at the meeting of the section, and one has since reached the United States Weather Bureau. The instrument is designed primarily for use on airplanes.

Copies of the specimen volume of upper-air observations for the year 1923 were exhibited. The printed edition is 500 copies and the cost is £2 per copy. The work is a monument to the sagacity and untiring energy of the president of the Commission for the Exploration of the Upper Air, Sir Napier Shaw. The meteorological section of the union has contributed to the work by an appropriation of £500.

Each volume is in four parts, as follows:

Part 1 contains the *resolutions* that guided the commission in its preparation of the publication, definitions of units employed, and a list of the stations furnishing upper-air data.

Part 2 contains synoptic charts for the international days on which aerological data were obtained.

Part 3 contains the tabulated data.

Part 4 the indicator diagrams.

An effort is to be made to dispose of the edition of this first volume through subscriptions by institutions and individuals who are interested in aerological work. Volumes of data for more recent years will soon follow until finally it is hoped that the time elapsing between observing and publishing will be reduced to a minimum.

Other subjects treated in the report of the bureau include "A common unitary system for all the sciences comprised within the union," atmospheric dust, simplification of the calendar, and meteorological observations of the Pacific Ocean.

General Delcambre reported with reference to statements received in response to a resolution adopted at Madrid requesting the different weather services to report upon the scientific principles underlying their methods of forecasting. His comment was to the effect that more was said about the data employed than about the science involved. Most services base their forecasts on the movements of HIGHS and LOWS and the characteristic weather accompanying them.

On September 6 most of the time of both morning and afternoon sessions was devoted to solar radiation.

After the report of the chairman of the commission on solar radiation, with a supplemental report from Richardson on his special photometer, representatives of each country were called upon to state what was being done in their country in solar radiation. The resolutions of the American Union calling for arrangements whereby pyrheliometers in all countries may be brought into accord with some known pyrheliometric scale, and for the adoption

of standard methods of measuring and tabulating radiation intensity, were adopted. The existing radiation commission, with enlarged membership, was charged with carrying out the provisions of the resolutions, and also with preparing printed instructions for observers, and with testing and recommending standard glass screens for dividing the solar spectrum into sections. In this work the commission of the union is to cooperate as far as possible with the solar radiation commission of the International Meteorological Committee.

There were no sessions of the sections on September 7, the day being devoted to excursions to museums, art galleries, scientific institutions, and ancient and modern monuments in and about Prague.

On the morning of the 8th the section voted to purchase 25 copies of the published upper-air data for each of the next three years.

At the afternoon session it was reported that the weather charts of the North Atlantic, the preparation of which was authorized at the Madrid meetings, were not yet completed. It was voted to continue the allotment of £500, to extend the maps to cover the North Pacific Ocean, and that the data used should be for 1927 instead of for 1923.

At the sessions on September 9 a variety of subjects were under discussion, including the simplification of the calendar.

The terms of the two vice presidents and the secretary having expired, and as the secretary declined reelection, Captain Wehrle, of France, was elected secretary, and Dr. V. Bjerkness, of Norway, and Eredia, of Italy, were elected vice presidents.

On Saturday morning, September 10, the minutes of the meetings were read, corrected, and approved, as were also 22 resolutions that had been adopted at the sessions.

The final plenary meeting of the union was held on the afternoon of the 10th, at which time President Lallemand was unanimously elected to succeed himself for another term, and funds were allocated to carry on the work of the different sections.

Invitations were received from the delegates of both Sweden and Portugal to hold the next general assembly of the union in their country. In view of the fact that the bureau of the union had been authorized to ascertain if it would be agreeable to the International Astronomical Union to have the general assemblies of the two unions held in the same year and at places not greatly separated, it was voted to leave the selection of the time and place for holding the next general assembly to the Bureau of the Union. It was the general opinion that Stockholm would be the place.

This brought to a close what was by common consent considered the most important meeting yet held by the union. The attendance was large. While the printed list of delegates has not been received, an authoritative estimate places the number at 165.

The attendance at the meetings of the meteorological section was uniformly good, the subjects under discussion were important, and thanks to the skillful guidance of the chairman, Sir Napier Shaw, the discussions were interesting and enlightening.

The 22 resolutions that were adopted follow. They sum up the work done by the section at the meetings and what has been planned for the future.

Resolutions adopted by the meteorological section of the International Geodetic and Geophysical Union at Prague, September 3-10, 1927:

1

The section approves the report presented by the *Observatoire Météorologique National* of France on the inquiry relative to the scientific methods of weather forecasting applied by the central bureaus of the different countries. That institution is requested to deliver the publication which it has kindly undertaken as soon as possible before the next general assembly.

2

The section subscribes for 25 copies of the sample volume by the Commission on the High Atmosphere for the three years following 1923 at a rate not to exceed £3 per copy.

3

The assembly requests persons who publish memoirs in a language other than French, English, or German to add a résumé in one of these languages or in an artificial international language such as Esperanto or Ido.

4

In consideration of the progress accomplished by the network of observational stations in the Pacific Ocean the section considers it necessary that the experiment of publishing (in conformity with Resolution No. 26 of the Assembly of Madrid, which relates only to the Atlantic Ocean) daily synoptic charts be completed by extending them to include the entire Northern Hemisphere for the months of August, September, and October, 1927. The section urgently requests the central bureaus of the different countries to assist the editor in this undertaking by furnishing him the necessary data duly verified and in the form that will be proposed by him.

5

The section of meteorology compliments Professor Hanzlik on the important work that he has done, and expresses the desire that it may be completed with the information from other countries as yet not received. There is expressed the desire to see this report published, with the probable aid of the section of hydrology, in the proceedings of the section of meteorology.

6

The section calls the attention of geophysicists to the advantages of using, where practicable, geodynamic height in calculations and tables.

7

The section notes with satisfaction that the volume of tables of observations in the high atmosphere contains results at stations in tropical regions and in the Southern Hemisphere, especially sounding observations of wind in the high atmosphere and later of temperature at Hong Kong, sounding observations of wind in the high atmosphere at Colombo and D-wa in Ceylon, at seven stations in Brazil, at Pretoria, South Africa, on Willis Island, off the northeastern coast of Australia, and at Apia, in the South Pacific.

The section requests that the bureau of the union transmit a copy of this resolution to the proper authorities in the countries interested.

8

The section approves the proposal of M. Eredia with reference to the usefulness of considering what meteorological data are indispensable in indicating synthetically the climatological character of a given locality and requests M. Eredia to present a complete report on this matter at the next assembly.

9

The institutions that will receive Doctor Richardson's photometer are given permission to improve the same, provided they always undertake to make and publish the standardization of the instrument reconstructed.

10

The institutions that will receive the photometer are asked to publish in their own countries the results of the observations that they make and to report to the section of meteorology.

11

In view of the actinometric research by Professor Vološin in Czechoslovakia, the section of meteorology recommends this research to the Czechoslovakian institutions.

The section of meteorology of the International Geodetic and Geophysical Union is keenly interested in the results obtained by Doctor Pollak, privatdocent in the German University at Prague, in the elaboration of observational material from 150 European stations extending over a period of 10 years.

The section hopes that the work will be carried on and extended to other regions with the support of the State Statistical Service of the Republic of Czechoslovakia.

13

The section desires that copies of the minutes of the meeting, including papers presented, be placed in the greatest measure possible at the disposal of meteorological investigators and that a list of those to whom copies should be sent be prepared by the national committees.

The section requests that the bureau of the union combine the lists prepared by the national committees and make arrangement for the distribution of the minutes.

14

The section approves the appointment of a commission to consider the question of relations between the section of meteorology of the International Geodetic and Geophysical Union and the International Meteorological Committee. (See resolution adopted at Utrecht.)

The commission consists of: Sir Napier Shaw, president; General Delcambre, Professor Van Everdingen, Sir Gilbert Walker, and Doctor Hesselberg.

15

The section has a lively interest in the proposal relative to the preparation of daily synoptic charts of the South Pacific Ocean. It is of the opinion that an effort should be made to extend the scope of the charts and to have them include all of the Southern Hemisphere for the months chosen for the specimen volume of charts of the Northern Hemisphere and ultimately to publish the charts for this period. The section names a commission, Sir Napier Shaw, president; Andrew Thomson (Samoa), Doctor Kitson (New Zealand), R. G. K. Lempfert, and representatives of the meteorological services of Argentina, Brazil, and Chile, which will be charged with putting this resolution into effect.

The section authorizes the president to set apart the sum of £100 sterling, if it is available, for the expenses of preparation and publication.

16

The section joins with the American Geophysical Union in expressing its great pleasure and satisfaction in the purpose of the Smithsonian Institution and the National Geographic Society to maintain stations for a period of at least four years in North America, South America, and Southwest Africa.

17

The Astrophysical Observatory of the Smithsonian Institution is requested to publish as early as practicable the observations of these stations for all of the period during which they function.

18

The section of meteorology of the International Geodetic and Geophysical Union authorizes its commission for solar radiation—
(a) To encourage by all possible means the maintenance of an international network of pyrheliometric stations for measuring the intensity of solar energy.

(b) To include in this network as many high-level stations as possible.

(c) To make provision that at the high-level stations especially careful attention be given to the measurement of ultra-violet radiation and the ozone content of the atmosphere.

19

The above-named commission is authorized to cooperate with the commission for solar radiation of the International Meteorological Committee in arranging for the intercomparison of sub-standard pyrheliometers in use in the different countries, in preparing a program and practical instructions to be recommended for the daily observations, and in securing the prompt publication of monthly summaries of results.

Messrs. Kimball (chairman), Ångström, Gorczyński, Simpson, Platania, Maurain, Fabry, Mercanton, Sverdrup, Messeguer, Hurst, Thomson, Hunt, Dobson, Normand, Stewart, Dedeant, Patterson, and Vološin were named as members of this commission.

M. Delcambre signified his willingness to take charge of the printing of the instructions.

20

The bureau of the section is authorized and requested to draw up a report on the various practices of the different sciences comprised within the International Geodetic and Geophysical Union with regard to units of measurement and to invite the cooperation of the bureaus of the other sections of the union, with the ultimate object of a common unitary system for all the sciences comprised within the union.

21

The section approves the appointment of a commission to consider the question of the use of geopotential in the geophysical sciences as the vertical coordinate in the representation of the position of a point with reference to the earth for the purposes of geodynamic problems.

The commission representing the different sections of the union is constituted as follows: Seismology, Oddone; meteorology,

22

Shaw; oceanography, Martin Knudson; geodesy, Bulloni and Norland; vulcanology, Tanakadate; magnetism, Chapman; and hydrology, Wallen.

In view of the increased importance of the application of meteorological statistics of the weather to the problems of agriculture, public health, and other aspects of public economics, the bureau of the section is authorized to ask the International Conference of Directors of Meteorological Réseaux to receive a deputation of the section at a meeting of the directors in 1929 (which may be regarded as a jubilee celebration of the International Meteorological Congress at Rome) in order to urge the consideration of a more scientific grouping of meteorological statistics than the customary one by calendar months of arbitrary and unequal length.

And, further, upon receipt of a favorable reply, the directors of the bureau are authorized to arrange the deputation on behalf of the section.

PERFORMANCE IN LONG-RANGE WEATHER FORECASTING¹

By CHARLES F. BROOKS

[Clark University, Worcester, Mass., August 18, 1927]

SYNOPSIS

Long-range forecasts are so much desired that any number of unqualified persons issue them without regard for criteria of performance. Among what might be called "fake" forecasts are the almanac, astrological, pseudosolar, and "mathematical" sorts, many of them calamity howls. The "prediction" of climatic normals, forecasts from phenomena on certain dates and from the behavior or aspects of certain animals or plants also belong in this category.

To be of value a forecast must be specific, limited as to place and time, and it must have a probability of more than chance verification. Furthermore, the economic consequences of failures, both in the long run and in a small sequence of years, must be reckoned. A forecast that will not hit the mark four times out of five, or at least once out of every three in succession, can not be of much value, though some claim that a forecast verified only three times out of five would be useful. The uncertainties of meteorological relationships on which any long-range forecasts can now be based are generally too great to permit reputable meteorologists to forecast on expectations of less than 75 or 80 per cent verification. A critical study of the methods now used in the attempts at scientific long-range weather forecasting and an evaluation of their relative merits for different parts of the world is much needed.

Nature of long-range forecasting.—What is long-range weather forecasting? This question at once raises thoughts of forecasting now what the weather for next month, next summer, next fall and winter will be. The long-range forecast is beyond the realm of storms already in existence and which by their movement may be likely to affect us some time next week. Long-range forecasting, dealing with the weather abnormalities of particular months and seasons, therefore, has but little in common with day-to-day forecasting or with its extension, the forecasting on Saturday what the general character of the weather during the coming week will be. (1)

Value of and demand for long-range forecasts.—Farmers, city people, merchants, manufacturers, politicians, statesmen, engineers, all would find many uses for general scientific weather forecasts a month or more in advance. The farmer has good need for them. In the opinion of a county farm adviser, for example:

In general, accurate seasonal forecasting would tend to establish a more permanent type form of agriculture, insure more profitable crops, enable the farmer to replenish and maintain soil fertility and reduce somewhat the hazards of agriculture. (2).

For want of such forecasts, western farmers have paid a "rainmaker" thousands of dollars at a time (3). Business men (4), transportation people (5), and water-supply

or power engineers (6) especially value advance indications of seasonal weather, even when of a general character. "In many lines of goods," says Douglas, "the general character of the weather has a definite and direct influence on sales; in others the effect is present but indirect; therefore, any predictions of the general character of the weather months in advance are of decided value to the business man. Without predictions the weather factor becomes guesswork." (4) "Waste of water could be reduced," says Rowe, "thus making it possible to increase the area of agricultural land cultivated." (6) In other words, reasonably dependable long-range weather forecasts would reduce the cost of living.

Fake forecasts; almanac, astrological, and others.—*The fight against them.*—There is no use discussing in detail here those "forecasts" of the almanac kind, detailing or generalizing, on some worthless scheme, the weather usual for each month (7). "Poor Robin" (8) and Dean Swift's satire on Partridge two centuries ago (9) were the opening shots of the long campaign against quack forecasters. Nor need we feel concerned when given "warnings" of weather disasters "impending" a fortnight to a year or more in advance. Howlers of such calamities have been roundly attacked by scientists time and again. In 1875 C. M. Woodward's dramatic exposé of one planetary scheme led the way for other scientific attacks in this country (10). Weather Bureau officials and others, notably Cleveland Abbe (11), and Garriott (12), Moore alone (13), and with several other officials (14), Wren (15), Walz (16), Marvin (17), Carpenter (18), editors (19) and other writers have been unsparing of their criticism of the fake or inadequate systems in use in the United States. Here during the past 10 years well over 50 long-rangers of greater or lesser repute have been publishing and, in a great many cases, accepting money for worthless or damaging forecasts. European countries also support quack forecasters in number, against whom the attacks of scientists have been as strong as in the United States (20). Hellmann lists 96 by name and analyzes and criticizes their methods (20). He characterizes such prophets as "conceited, positive, more or less fanatic, eager for a fray." He says they use the same method against critics—picking out the best hits and keeping the poor ones silent. They are self-praising; they quote

¹ Essentially as presented at U. S. Weather Bureau Staff Meeting, Washington, D. C., May 13, 1926.